

EXPRESS MAIL LABEL NO.:

EL662235577US

DATE: December 6, 2001

JC07 Rec'd PCT/PTO 06 DEC 2001

FORM PTO 1390 (REV 11-2000)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER B&LAB-009
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 10/009052
INTERNATIONAL APPLICATION NO. PCT/SE00/01052	INTERNATIONAL FILING DATES 24 May 2000	PRIORITY DATE CLAIMED 10 June 1999	
TITLE OF INVENTION METHOD AND SYSTEM FOR CONVEYING SHREDDERED PULP TO AN OZONE REACTOR			
APPLICANT(S) FOR DO/EO/US Monica Bokström and Per Åström			
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:			
<ol style="list-style-type: none"> 1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing 35 U.S.C. 371 3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371 (f)). The submission must include items (5), (6), (9) and (21) indicated below. 4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (PCT Article 31). 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371 (c)(2)) <ol style="list-style-type: none"> a. <input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau). b. <input checked="" type="checkbox"/> has been communicated by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). 6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371 (c)(2)). <ol style="list-style-type: none"> a. <input type="checkbox"/> is attached hereto. b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4). 7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3)) <ol style="list-style-type: none"> a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau). b. <input type="checkbox"/> have been communicated by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input checked="" type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)). 9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)). (Executed) 10. <input type="checkbox"/> An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)). 			
Items 11 to 20 below concern document(s) or information included:			
<ol style="list-style-type: none"> 11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. w/PTO-1449, 2 references 12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. 13. <input checked="" type="checkbox"/> A FIRST preliminary amendment. 14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. 15. <input checked="" type="checkbox"/> A substitute specification. 16. <input type="checkbox"/> A change of power of attorney and/or address letter. 17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825. 18. <input checked="" type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4). 19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4). 20. <input checked="" type="checkbox"/> Other items or information: Substitute Abstract, Marked-up Specification, Copy of International Preliminary Examination Report, One (1) Sheet of Formal Drawings 			

U.S. APPLICATION NO (if known, see 37 CFR 1.5) 10/009052	INTERNATIONAL APPLICATION NO PCT/SE00/01052	ATTORNEY'S DOCKET NUMBER B&LAB-009
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17. ☒ The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) – (5)):

☒ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO\$1040.00

☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$890.00

☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$740.00

☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$710.00

☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =

Surcharge of \$ _____ for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	*12-20		x	\$	0.00
Independent claims	1-3 =		x	\$	0.00
MULTIPLE DEPENDENT CLAIM(s) (if applicable)			+	\$	
TOTAL OF ABOVE CALCULATIONS =				\$	1,040.00
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.				\$	
SUBTOTAL =				\$	1,040.00
Processing fee of \$ _____ for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				\$	
TOTAL NATIONAL FEE =				\$	1,040.00
Fee for recording the enclosed assignment (37 CFR 1.21 (h)). Assignment must be accompanied by appropriate cover sheet (37 CFR 3.28, 3.31) (_____ per property).				+ \$	SEE RECORDATION FORM COVER SHEET
TOTAL FEES ENCLOSED =				\$	1,040.00

* As In Preliminary Amendment	Amount to be Refunded:	\$
	Charged:	\$


a. ☐ A check in the amount of \$ _____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 12-1095 in the amount of \$ 1,040.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required or credit any overpayment to my Deposit Account No. 12-1095. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
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REGISTRATION NUMBER
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10/009052

JG12 Rec'd PCTK70 06 DEC 2001

PATENT

B&LAB 3.3-009

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of
Monica BOKSTRÖM et al.

International Application No.
PCT/SE00/01052

International Filing Date:
24 May 2000

For: METHOD AND SYSTEM FOR CONVEYING
SHREDDED PULP TO AN OZONE REACTOR

Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Sir: Preliminary to initiation of the prosecution of the above-identified pending U.S. patent application, the following amendments and remarks are respectfully submitted.

IN THE ABSTRACT

Please delete the Abstract as filed and substitute therefor the attached revised Abstract.

IN THE SPECIFICATION

Please amend the Specification in accordance with the attached revised Specification.

IN THE CLAIMS

Please cancel claims 1-10 and add new claims 11-22.

11. (NEW) A method of treating pulp, comprising:

- dewatering said pulp to a fiber concentration of at least 20%;

- shredding said dewatered pulp in a closed pulp shredding vessel;

- transporting said shredded pulp without compression continuously out of said pulp shredding vessel through an outlet

EXPRESS MAIL LABEL NUMBER: EL662235577US

pipe therefrom, so that said outlet pipe is kept completely filled with passing pulp,

- directly transporting said shredded pulp from said outlet pipe of said pulp shredding vessel to a reaction vessel through a gas-tight conduit, which is gas sealed from the surroundings, the interior of said conduit communicating with the interior of said outlet pipe and with the interior of said reaction vessel;

- bleaching said shredded pulp in said reaction vessel through reaction with ozone gas; and

- regulating the gas pressure in said pulp shredding vessel and the gas pressure in said reaction vessel so that ozone gas is prevented from leaking upstream through said outlet pipe.

12. (NEW) A method according to claim 11, further comprising keeping the gas pressure in said pulp shredding vessel higher than the gas pressure in said reaction vessel.

13. (NEW) A method according to claim 12, further comprising regulating the pressure difference between the gas pressure in said pulp shredding vessel and the gas pressure in said reaction vessel towards a predetermined value.

14. (NEW) A method according to claim 13, further comprising keeping the gas pressures in said pulp shredding vessel and said reaction vessel below the surrounding atmospheric pressure.

15. (NEW) A method according to claim 11, further comprising transporting said shredded pulp by gravity in said gas-tight conduit.

16. (NEW) A method according to claim 11, further comprising shredding said pulp in said pulp shredding vessel by a transport screw with at least one toothed transport thread, and transporting said shredded pulp by said transport screw through said outlet pipe of said pulp shredding vessel.

17. (NEW) A system for treatment of pulp, comprising:
a dewatering device for dewatering said pulp to a fiber concentration of at least 20%,

a pulp shredding device for shredding said dewatered pulp, said pulp shredding device including a closed pulp shredding vessel, an outlet pipe from said pulp shredding vessel, and a transport means adapted to continuously transport said shredded pulp without compressing the pulp out of said pulp shredding vessel through said outlet pipe, so that said outlet pipe is kept filled with passing pulp,

a reaction vessel for bleaching said shredded pulp through reaction with ozone gas,

a conduit gas sealed from the surroundings and connecting said outlet pipe of said pulp shredding vessel gas-tightly to said reaction vessel, so that the interior of said outlet pipe directly communicates with the interior of said reaction vessel through the interior of said conduit,

and a pressure regulation device for regulating the gas pressure in said pulp shredding vessel and the gas pressure in said reaction vessel so that ozone gas is prevented from leaking upstream through said outlet pipe.

18. (NEW) A system for treatment of pulp according to claim 17, wherein said pressure regulation device is adapted to maintain the gas pressure in said pulp shredding vessel higher than the gas pressure in said reaction vessel.

19. (NEW) A system for treatment of pulp according to claim 18, wherein said transport means comprises a transport screw extending in said pulp shredding vessel and provided with at least one toothed transport thread for shredding the pulp.

20. (NEW) A system for treatment of pulp according to claim 19, wherein said transport screw also extends in said outlet pipe of said pulp shredding vessel.

21. (NEW) A system for treatment of pulp according to claim 17, wherein said pressure regulation device regulates the pressure difference between the gas pressure in said pulp shredding vessel and the gas pressure in said reaction vessel towards a predetermined value.

22. (NEW) A system for treatment of pulp according to claim 21, wherein said pressure regulation device comprises a

first fan with controllable capacity arranged in a gas outlet in said pulp shredding vessel for evacuation of gas therefrom, a second fan with controllable capacity arranged in a gas outlet in said reaction vessel for evacuation of gas therefrom, a first pressure sensor for sensing the gas pressure in said pulp shredding vessel, a second pressure sensor for sensing the gas pressure in said reaction vessel, and a regulation unit which in response to said first and second pressure sensors, respectively, regulates the capacity of said first and second fans, respectively.

REMARKS

The above-noted cancellation of claims 1-10, and addition of new claims 11-22, as well as the submission of a new Abstract and revisions to the Specification, are respectfully submitted prior to initiation of the prosecution of this application in the U.S. Patent and Trademark Office.

The above-noted new claims are respectfully submitted in order to more clearly and appropriately claim the subject matter which applicant considers to constitute his inventive contribution. No new matter is included in these amendments. In addition, the revisions to the Abstract and Specification are submitted in order to clarify and correct the Abstract and Specification and to conform them to all of the requirements of U.S. practice. No new matter is included in these amendments.

In view of the above, it is respectfully requested that these amendments now be entered, and that prosecution on the merits of this application now be initiated. If, however, for any reason the Examiner does not believe such action can be taken, it is respectfully requested that he telephone applicant's attorney at (908) 654-5000 in order to overcome any objections which he may have.

Application No. PCT/SE00/01052

If there are any additional charges in connection with this requested amendment, the Examiner is authorized to charge applicant's Deposit Account No. 12-1095 therefor.

Respectfully submitted,

LERNER, DAVID, LITTENBERG,
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METHOD AND SYSTEM FOR CONVEYING SHREDDED PULP TO AN OZONE REACTOR

FIELD OF THE INVENTION

[0001] The present invention relates to a method of treatment of pulp, which in a dewatering step is dewatered to a fibrefiber concentration of at least 20% and which in a later bleaching step is bleached in an reactor vessel through reaction with ozone gas. ~~The~~ More particularly, the present invention also relates to a system for treatment of pulp, comprising a dewatering device for dewatering the pulp to a fibrefiber concentration of at least 20%, and a reactor vessel for bleaching the dewatered pulp through reaction with ozone gas.

BACKGROUND OF THE INVENTION

[0002] In traditional systems for ozone bleaching of pulp at a high pulp concentration the pulp has to undergo a process comprising a number of preparatory treatment steps before the pulp can finally ~~can be~~ bleached with ozone gas in the reactor vessel. Thus, the pulp is dewatered in an initial dewatering step in the dewatering device, usually in the form of a twin roll press. The dewatered pulp is shredded in a subsequent pulp shredding step in a shredder. The dewatered and shredded pulp is then transported in a transporting step, usually by a plug screw, from the shredder to a fluffer, in which the pulp is fluffed in a fluffing step. Once the pulp has undergone these preparatory steps it can be bleached in the reactor vessel.

[0003] The function of ~~said the~~ the plug screw is to compress the shredded pulp to a plug forming a gas lock preventing ozone gas from leaking from the reaction vessel upstream in the system to the surroundings. The function of the fluffer is to fluff up the compressed pulp leaving the pulp screw, so that the pulp gets a large specific surface, which facilitates the reaction of the ozone gas with the lignin of the pulp. Thus, the pulp entering the reactor vessel has to be fluffed, in order to obtain a high ozone ~~utilisation~~utilization and a good bleaching selectivity.

[0004] ~~WO 9605365A1~~ International Application No. WO 06/05365 A1 shows a known pulp treatment system comprising a pulp plug

forming plug-screw for transportation of dewatered and shredded pulp to a fluffer, and a reaction vessel containing pulp bleaching gas.

[0005] Thus, the above described traditional pulp treatment system for bleaching pulp with ozone gas is relatively extensive and consequently expensive, which is a disadvantage. In addition, with several treatment steps in the process the entire system will be more sensitive to disturbances in each single part of the process. Therefore it would be of advantage if one or more treatment steps could be eliminated.

[0006] ~~An~~ One object of the present invention is to provide a new method for treating pulp, which is bleached through reaction with ozone gas, which method is simpler and more reliable than traditional methods and results in an efficient ozone ~~utilisation~~utilization for the bleaching of the pulp.

SUMMARY OF THE INVENTION

[0007] In accordance with the present invention, this and other objects have now been realized by the invention of a method of treating pulp, comprising dewatering the pulp to a fiber concentration of at least 20%, shredding the dewatered pulp in a closed pulp shredding vessel, transporting the shredded pulp without compression continuously out of the pulp shredding vessel through an outlet pipe therefrom, so that the outlet pipe is kept completely filled with passing pulp, directly transporting the shredded pulp from the outlet pipe of the pulp shredding vessel to a reaction vessel through a gas-tight conduit, which is gas sealed from the surroundings, the interior of the conduit communicating with the interior of the outlet pipe and with the interior of the reaction vessel, bleaching the shredded pulp in the reaction vessel through reaction with ozone gas, and regulating the gas pressure in the pulp shredding vessel and the gas pressure in the reaction vessel so that ozone gas is prevented from leaking upstream through the outlet pipe. In a preferred embodiment, the method further comprises keeping the gas pressure in the pulp shredding vessel higher than the gas pressure in the reaction vessel. Preferably, the method further

includes regulating the pressure difference between the gas pressure in the pulp shredding vessel and the gas pressure in the reaction vessel towards a predetermined value. Most preferably, the method further includes keeping the gas pressures in the pulp shredding vessel and the reaction vessel below the surrounding atmospheric pressure.

[0008] In accordance with one embodiment of the method of the present invention, the method further comprises transporting the shredded pulp by gravity in the gas-tight conduit.

[0009] In accordance with another embodiment of the method of the present invention, the method further comprises shredding the pulp in the pulp shredding vessel by a transport screw with at least one toothed transport thread, and transporting the shredded pulp by the transport screw through the outlet pipe of the pulp shredding vessel.

[0010] In accordance with the present invention, a system has also been provided for the treatment of pulp comprising a dewatering device for dewatering the pulp to a fiber concentration of at least 20%, a pulp shredding device for shredding the dewatered pulp, the pulp shredding device including a closed pulp shredding vessel, an outlet pipe from the pulp shredding vessel, and a transport means adapted to continuously transport the shredded pulp without compressing the pulp out of the pulp shredding vessel through the outlet pipe, so that the outlet pipe is kept filled with passing pulp, a reaction vessel for bleaching the shredded pulp through reaction with ozone gas, a conduit gas sealed from the surroundings and connecting the outlet pipe of the pulp shredding vessel gas-tightly to the reaction vessel, so that the interior of the outlet pipe directly communicates with the interior of the reaction vessel through the interior of the conduit, and a pressure regulation device for regulating the gas pressure in the pulp shredding vessel and the gas pressure in the reaction vessel so that ozone gas is prevented from leaking upstream through the outlet pipe. Preferably, the pressure regulation device is adapted to maintain the gas pressure in the pulp shredding vessel higher than the gas

pressure in the reaction vessel. In a preferred embodiment, the transport means comprises a transport screw extending in the pulp shredding vessel and provided with at least one toothed transport thread for shredding the pulp. In a preferred embodiment, the transport screw also extends in the outlet pipe of the pulp shredding vessel.

[0011] In accordance with one embodiment of the system of the present invention, the pressure regulation device regulates the pressure difference between the gas pressure in the pulp shredding vessel and the gas pressure in the reaction vessel towards a predetermined value. In a preferred embodiment, the pressure regulation device comprises a first fan with controllable capacity arranged in a gas outlet in the pulp shredding vessel for evacuation of gas therefrom, a second fan with controllable capacity arranged in a gas outlet in the reaction vessel for evacuation of gas therefrom, a first pressure sensor for sensing the gas pressure in the pulp shredding vessel, a second pressure sensor for sensing the gas pressure in the reaction vessel, and a regulation unit which in response to the first and second pressure sensors, respectively, regulates the capacity of the first and second fans, respectively.

[0012] ~~This object is~~ The objects of the present invention are achieved by the ~~a~~ method stated initially, which is characterised in that ~~which~~, after the dewatering step and before the bleaching step, the pulp is shredded in a closed pulp shredding vessel, the shredded pulp is transported without compression continuously out of the pulp shredding vessel through an outlet pipe therefrom, so that the outlet pipe is kept filled with passing pulp, from the outlet pipe of the pulp shredding vessel the shredded pulp is directly transported to the reaction vessel through a conduit which is gas sealed from the surroundings, the interior of the conduit communicating with the interior of the outlet pipe and with the interior of the reactor vessel, and the gas pressure in the pulp shredding vessel is kept higher than the gas pressure in the reactor vessel.

[0013] It has been proved that the combination of the two

measures - (1) to keep the outlet pipe filled with passing shredded non- compressed pulp, and - (2) to maintain the gas pressure in the pulp shredding vessel higher than that of the reactor vessel, is sufficient to prevent ozone gas from leaking upstream out to the surroundings. ~~Hereby~~ In this manner, neither a plug screw nor a fluffer is needed, which makes the new method according to the present invention particularly simple and reliable.

[0014] Advantageously, the pressure difference between the gas pressure in the pulp shredding vessel and the gas pressure in the reactor vessel is regulated towards a predetermined value, wherein the gas pressures in the pulp shredding vessel and the reactor vessel are suitably kept under the surrounding atmospheric pressure.

[0015] Preferably, the shredded pulp is transported in the gas-tight conduit by the aid of gravity without need for any mechanical transportation means.

[0016] In the pulp shredding vessel the pulp is advantageously shredded by a transport screw with at least one toothed thread, wherein the transport screw also provides the transportation of the shredded pulp through the outlet pipe of the pulp shredding vessel.

[0017] A further object of the present invention is to provide a new system for treating pulp, which is bleached through reaction with ozone gas, which system is simpler than the above described traditional systems and eliminates the above mentioned disadvantages and problems thereof.

[0018] This object is obtained by ~~the~~ a system ~~stated initially, in which is characterised by there is provided~~ a pulp shredding device for shredding the dewatered pulp, which pulp shredding device comprises a closed pulp shredding vessel, an outlet pipe from the pulp shredding vessel, and a transport means for continuous transport of the shredded pulp without compressing the pulp out of the pulp shredding vessel ~~via~~ through the outlet pipe, so that the latter is kept filled with passing pulp, a conduit which is gas sealed from the surroundings and which

connects the outlet pipe of the pulp shredding vessel gas tightly to the reaction vessel, so that the interior of the outlet pipe directly communicates with the reaction vessel ~~via~~ through the interior of the conduit, and a pressure regulation device for maintaining a gas pressure in the pulp shredding vessel which is higher than that of the reaction vessel.

[0019] According to a preferred embodiment of the system according to the present invention the transport means comprises a transport screw extending in the pulp shredding vessel, preferably also in the outlet pipe of the pulp shredding vessel, and which is provided with at least one toothed thread for shredding the pulp.

[0020] Advantageously the pressure regulation device regulates the pressure difference between the gas pressure in the pulp shredding vessel and the gas pressure in the reactor vessel toward a predetermined value.

[0021] Preferably the pressure regulation device comprises a first fan with a controllable capacity arranged in a gas outlet in the pulp shredding vessel for evacuation of gas therefrom, a second fan with controllable capacity arranged in a gas outlet in the reactor vessel for evacuation of gas therefrom, a first pressure sensor for sensing the gas pressure in the pulp shredding vessel, a second pressure sensor for sensing a gas pressure in the reaction vessel, and a regulation unit which in response to the first and second pressure sensors, respectively, regulates the capacity of the first and second fans, respectively.

~~The invention is described in more detail in the following with reference to the accompanying drawing, in which figure 1 schematically shows an example of the system according to the present invention, and figure 2 and 3, respectively, is a cross section along the line II-II and III-III, respectively, in figure 1.~~

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The present invention may be more fully appreciated with reference to the following detailed description which, in

turn, refers to the accompanying drawings, in which:

[0023] Figure 1 is a side, elevational, partially schematic representation of a system according to the present invention;

[0024] Figure 2 is a side, elevational, partially sectional view of a portion of the system shown in figure 1 taken along line II-II thereof; and

[0025] Figure 3 is a side, elevational, partially sectional view of a portion of the system shown in figure 1 taken along line III-III thereof.

DETAILED DESCRIPTION

[0026] The drawings ~~shows~~ show a system for treatment of pulp comprising a dewatering device 2, a pulp shredding device 4 and a reaction vessel 6 for bleaching of pulp through reaction with ozone gas. The dewatering device 2 comprises two pressure rolls 8, which are arranged to counter rotate in a housing 10, and an inlet 12 for pulp to be dewatered in the lower part of the housing 10. A motor 14 provides for the rotation of the pressure rolls 8. An elongated closed pulp shredding vessel 16 extends along the pressure rolls 8 above these. In the pulp shredding vessel 16 a transport screw 18 extends in parallel with the pressure rolls 8. Another motor 20 is adapted to rotate the transport screw 18. The pulp shredding vessel 16 has a lower elongated inlet for pulp to be dewatered by the pressure rolls 8 (see figure 2) and an outlet pipe 22, through which the transport screw 18 extends in part, for dewatered and shredded pulp.

[0027] The transport screw 18 has a core 24 with a constant diameter and a toothed transport thread 26 with a constant pitch and diameter. The portion of the transport thread 26 extending in the outlet pipe 22 may alternatively be non-toothed. The interior of the outlet pipe 22 also has a constant diameter which is somewhat larger than the diameter of the transport thread 26. Alternatively the transport screw 18 may have more than one transport thread 26.

[0028] A vertical gas-tight conduit 28 connects the outlet pipe 22 gas-tightly to an upper inlet 30 in the reaction vessel 6, so that the interior of the outlet pipe 22 directly

communicates with the interior of the reaction vessel 6 via through the interior of the conduit 28. The reaction vessel 6 has a lower outlet conduit 32 provided with a valve 34, for discharge of bleached pulp, and an upper outlet conduit 36 for evacuation of gas. There is also a device, not shown, for supplying ozone gas to the interior of the reaction vessel 6.

[0029] A regulation unit 38 is by means of signal lines connected to a pressure sensor 40 for sensing the gas pressure P1 in the pulp shredding vessel 16 and to a pressure sensor 42 for sensing the gas pressure P2 in the reaction vessel 6. The regulation unit 38 is by means of further signal lines also connected to a fan 44 with a controllable capacity located in an upper outlet conduit 46 from the pulp shredding vessel 16, and to another fan 48 likewise with a controllable capacity located in the upper outlet conduit 36 of the reaction vessel 6.

[0030] During operation a pulp suspension is pumped through the inlet 12 of the dewatering device 2 to the pressure rolls 8, which are counter rotated by the motor 14, the direction of rotation of the pressure rolls being indicated by arrows in figure 3, so that the pulp is pulled between the pressure rolls 8 while being dewatered up to the inlet of the pulp shredding vessel 16. When entering the inlet of the pulp shredding vessel 16 the dewatered pulp has a ~~fibrefiber~~ fiber concentration of 20-45%. In the pulp shredding vessel 16 the pulp is shredded by the toothed transport thread 26 of the transport screw 18, which is rotated by the motor 20. Depending on the desired result the toothing of the transport thread 26 may be shaped so that a relatively coarse or fine shredding of the pulp is obtained. In addition the transport screw 18 transports shredded pulp through the outlet pipe 22 without compressing the pulp. From the outlet pipe 22 the shredded pulp drops through the vertical conduit 28 to the reaction vessel 6, where the pulp is bleached through reaction with ozone gas. Finally the bleached pulp is discharged from the reactor vessel 6 through the lower outlet conduit 32.

[0031] The regulation unit 38 controls the capacity of the fans 44 and 48, for instance by speed control, in response to the

pressure sensors 40 and 42, so that the gas pressure P1 in the pulp shredding vessel 16 is kept higher than the gas pressure P2 in the reaction vessel 6. At least the gas pressure P2 is kept by the regulation unit 38 below the surrounding atmospheric pressure. Suitably the regulation unit 38 keeps the gas pressure P1 in the range of 0-14 kPa (overpressure) and the gas pressure P2 in the range 1-15 kPa (overpressure) at the same time as the regulation unit 38 regulates the pressure difference between the gas pressures P1 and P2 towards a predetermined value, which is chosen in the range of ~~0,5-1,5~~ about 0.5 to 1.5 kPa.

[0032] By the fact that the shredded and fluffed pulp transported by the transport screw 18 through the outlet pipe 22 completely fills the latter at the same time as the gas pressure is decreased from the interior of the pulp shredding vessel to the interior reactor vessel, ozone gas is efficiently prevented from passing upstream in the system to the surroundings.

[0033] Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

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METHOD AND SYSTEM FOR CONVEYING
SHREDDED PULP TO AN OZONE REACTOR

FIELD OF THE INVENTION

[0001] The present invention relates to a method of treatment of pulp, which in a dewatering step is dewatered to a fiber concentration of at least 20% and which in a later bleaching step is bleached in a reactor vessel through reaction with ozone gas. More particularly, the present invention also relates to a system for treatment of pulp, comprising a dewatering device for dewatering the pulp to a fiber concentration of at least 20%, and a reactor vessel for bleaching the dewatered pulp through reaction with ozone gas.

BACKGROUND OF THE INVENTION

[0002] In traditional systems for ozone bleaching of pulp at a high pulp concentration the pulp has to undergo a process comprising a number of preparatory treatment steps before the pulp can finally be bleached with ozone gas in the reactor vessel. Thus, the pulp is dewatered in an initial dewatering step in the dewatering device, usually in the form of a twin roll press. The dewatered pulp is shredded in a subsequent pulp shredding step in a shredder. The dewatered and shredded pulp is then transported in a transporting step, usually by a plug screw, from the shredder to a fluffer, in which the pulp is fluffed in a fluffing step. Once the pulp has undergone these preparatory steps it can be bleached in the reactor vessel.

[0003] The function of the plug screw is to compress the shredded pulp to a plug forming a gas lock preventing ozone gas from leaking from the reaction vessel upstream in the system to the surroundings. The function of the fluffer is to fluff up the compressed pulp leaving the pulp screw, so that the pulp gets a large specific surface, which facilitates the reaction of the ozone gas with the lignin of the pulp. Thus, the pulp entering the reactor vessel has to be fluffed, in order to obtain a high ozone utilization and a good bleaching selectivity.

[0004] International Application No. WO 06/05365 A1 shows a known pulp treatment system comprising a pulp plug forming

plugscrew for transportation of dewatered and shredded pulp to a fluffer, and a reaction vessel containing pulp bleaching gas.

[0005] Thus, the above described traditional pulp treatment system for bleaching pulp with ozone gas is relatively extensive and consequently expensive, which is a disadvantage. In addition, with several treatment steps in the process the entire system will be more sensitive to disturbances in each single part of the process. Therefore it would be of advantage if one or more treatment steps could be eliminated.

[0006] One object of the present invention is to provide a new method for treating pulp, which is bleached through reaction with ozone gas, which method is simpler and more reliable than traditional methods and results in an efficient ozone utilization for the bleaching of the pulp.

SUMMARY OF THE INVENTION

[0007] In accordance with the present invention, this and other objects have now been realized by the invention of a method of treating pulp, comprising dewatering the pulp to a fiber concentration of at least 20%, shredding the dewatered pulp in a closed pulp shredding vessel, transporting the shredded pulp without compression continuously out of the pulp shredding vessel through an outlet pipe therefrom, so that the outlet pipe is kept completely filled with passing pulp, directly transporting the shredded pulp from the outlet pipe of the pulp shredding vessel to a reaction vessel through a gas-tight conduit, which is gas sealed from the surroundings, the interior of the conduit communicating with the interior of the outlet pipe and with the interior of the reaction vessel, bleaching the shredded pulp in the reaction vessel through reaction with ozone gas, and regulating the gas pressure in the pulp shredding vessel and the gas pressure in the reaction vessel so that ozone gas is prevented from leaking upstream through the outlet pipe. In a preferred embodiment, the method further comprises keeping the gas pressure in the pulp shredding vessel higher than the gas pressure in the reaction vessel. Preferably, the method further includes regulating the pressure difference between the gas

pressure in the pulp shredding vessel and the gas pressure in the reaction vessel towards a predetermined value. Most preferably, the method further includes keeping the gas pressures in the pulp shredding vessel and the reaction vessel below the surrounding atmospheric pressure.

[0008] In accordance with one embodiment of the method of the present invention, the method further comprises transporting the shredded pulp by gravity in the gas-tight conduit.

[0009] In accordance with another embodiment of the method of the present invention, the method further comprises shredding the pulp in the pulp shredding vessel by a transport screw with at least one toothed transport thread, and transporting the shredded pulp by the transport screw through the outlet pipe of the pulp shredding vessel.

[0010] In accordance with the present invention, a system has also been provided for the treatment of pulp comprising a dewatering device for dewatering the pulp to a fiber concentration of at least 20%, a pulp shredding device for shredding the dewatered pulp, the pulp shredding device including a closed pulp shredding vessel, an outlet pipe from the pulp shredding vessel, and a transport means adapted to continuously transport the shredded pulp without compressing the pulp out of the pulp shredding vessel through the outlet pipe, so that the outlet pipe is kept filled with passing pulp, a reaction vessel for bleaching the shredded pulp through reaction with ozone gas, a conduit gas sealed from the surroundings and connecting the outlet pipe of the pulp shredding vessel gas-tightly to the reaction vessel, so that the interior of the outlet pipe directly communicates with the interior of the reaction vessel through the interior of the conduit, and a pressure regulation device for regulating the gas pressure in the pulp shredding vessel and the gas pressure in the reaction vessel so that ozone gas is prevented from leaking upstream through the outlet pipe. Preferably, the pressure regulation device is adapted to maintain the gas pressure in the pulp shredding vessel higher than the gas pressure in the reaction vessel. In a preferred embodiment, the

transport means comprises a transport screw extending in the pulp shredding vessel and provided with at least one toothed transport thread for shredding the pulp. In a preferred embodiment, the transport screw also extends in the outlet pipe of the pulp shredding vessel.

[0011] In accordance with one embodiment of the system of the present invention, the pressure regulation device regulates the pressure difference between the gas pressure in the pulp shredding vessel and the gas pressure in the reaction vessel towards a predetermined value. In a preferred embodiment, the pressure regulation device comprises a first fan with controllable capacity arranged in a gas outlet in the pulp shredding vessel for evacuation of gas therefrom, a second fan with controllable capacity arranged in a gas outlet in the reaction vessel for evacuation of gas therefrom, a first pressure sensor for sensing the gas pressure in the pulp shredding vessel, a second pressure sensor for sensing the gas pressure in the reaction vessel, and a regulation unit which in response to the first and second pressure sensors, respectively, regulates the capacity of the first and second fans, respectively.

[0012] The objects of the present invention are achieved by a method in which, after the dewatering step and before the bleaching step, the pulp is shredded in a closed pulp shredding vessel, the shredded pulp is transported without compression continuously out of the pulp shredding vessel through an outlet pipe therefrom, so that the outlet pipe is kept filled with passing pulp, from the outlet pipe of the pulp shredding vessel the shredded pulp is directly transported to the reaction vessel through a conduit which is gas sealed from the surroundings, the interior of the conduit communicating with the interior of the outlet pipe and with the interior of the reactor vessel, and the gas pressure in the pulp shredding vessel is kept higher than the gas pressure in the reactor vessel.

[0013] It has been proved that the combination of the two measures - (1) to keep the outlet pipe filled with passing shredded non-compressed pulp, and - (2) to maintain the gas

pressure in the pulp shredding vessel higher than that of the reactor vessel, is sufficient to prevent ozone gas from leaking upstream out to the surroundings. In this manner, neither a plug screw nor a fluffer is needed, which makes the new method according to the present invention particularly simple and reliable.

[0014] Advantageously, the pressure difference between the gas pressure in the pulp shredding vessel and the gas pressure in the reactor vessel is regulated towards a predetermined value, wherein the gas pressures in the pulp shredding vessel and the reactor vessel are suitably kept under the surrounding atmospheric pressure.

[0015] Preferably, the shredded pulp is transported in the gas-tight conduit by the aid of gravity without need for any mechanical transportation means.

[0016] In the pulp shredding vessel the pulp is advantageously shredded by a transport screw with at least one toothed thread, wherein the transport screw also provides the transportation of the shredded pulp through the outlet pipe of the pulp shredding vessel.

[0017] A further object of the present invention is to provide a new system for treating pulp, which is bleached through reaction with ozone gas, which system is simpler than the above described traditional systems and eliminates the above mentioned disadvantages and problems thereof.

[0018] This object is obtained by a system in which there is provided a pulp shredding device for shredding the dewatered pulp, which pulp shredding device comprises a closed pulp shredding vessel, an outlet pipe from the pulp shredding vessel, and a transport means for continuous transport of the shredded pulp without compressing the pulp out of the pulp shredding vessel through the outlet pipe, so that the latter is kept filled with passing pulp, a conduit which is gas sealed from the surroundings and which connects the outlet pipe of the pulp shredding vessel gas tightly to the reaction vessel, so that the interior of the outlet pipe directly communicates with the

reaction vessel through the interior of the conduit, and a pressure regulation device for maintaining a gas pressure in the pulp shredding vessel which is higher than that of the reaction vessel.

[0019] According to a preferred embodiment of the system according to the present invention the transport means comprises a transport screw extending in the pulp shredding vessel, preferably also in the outlet pipe of the pulp shredding vessel, and which is provided with at least one toothed thread for shredding the pulp.

[0020] Advantageously the pressure regulation device regulates the pressure difference between the gas pressure in the pulp shredding vessel and the gas pressure in the reactor vessel toward a predetermined value.

[0021] Preferably the pressure regulation device comprises a first fan with a controllable capacity arranged in a gas outlet in the pulp shredding vessel for evacuation of gas therefrom, a second fan with controllable capacity arranged in a gas outlet in the reactor vessel for evacuation of gas therefrom, a first pressure sensor for sensing the gas pressure in the pulp shredding vessel, a second pressure sensor for sensing a gas pressure in the reaction vessel, and a regulation unit which in response to the first and second pressure sensors, respectively, regulates the capacity of the first and second fans, respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The present invention may be more fully appreciated with reference to the following detailed description which, in turn, refers to the accompanying drawings, in which:

[0023] Figure 1 is a side, elevational, partially schematic representation of a system according to the present invention;

[0024] Figure 2 is a side, elevational, partially sectional view of a portion of the system shown in figure 1 taken along line II-II thereof; and

[0025] Figure 3 is a side, elevational, partially sectional view of a portion of the system shown in figure 1 taken along

line III-III thereof.

DETAILED DESCRIPTION

[0026] The drawings show a system for treatment of pulp comprising a dewatering device 2, a pulp shredding device 4 and a reaction vessel 6 for bleaching of pulp through reaction with ozone gas. The dewatering device 2 comprises two pressure rolls 8, which are arranged to counter rotate in a housing 10, and an inlet 12 for pulp to be dewatered in the lower part of the housing 10. A motor 14 provides for the rotation of the pressure rolls 8. An elongated closed pulp shredding vessel 16 extends along the pressure rolls 8 above these. In the pulp shredding vessel 16 a transport screw 18 extends in parallel with the pressure rolls 8. Another motor 20 is adapted to rotate the transport screw 18. The pulp shredding vessel 16 has a lower elongated inlet for pulp to be dewatered by the pressure rolls 8 (see figure 2) and an outlet pipe 22, through which the transport screw 18 extends in part, for dewatered and shredded pulp.

[0027] The transport screw 18 has a core 24 with a constant diameter and a toothed transport thread 26 with a constant pitch and diameter. The portion of the transport thread 26 extending in the outlet pipe 22 may alternatively be non-toothed. The interior of the outlet pipe 22 also has a constant diameter which is somewhat larger than the diameter of the transport thread 26. Alternatively the transport screw 18 may have more than one transport thread 26.

[0028] A vertical gas-tight conduit 28 connects the outlet pipe 22 gas-tightly to an upper inlet 30 in the reaction vessel 6, so that the interior of the outlet pipe 22 directly communicates with the interior of the reaction vessel 6 through the interior of the conduit 28. The reaction vessel 6 has a lower outlet conduit 32 provided with a valve 34, for discharge of bleached pulp, and an upper outlet conduit 36 for evacuation of gas. There is also a device, not shown, for supplying ozone gas to the interior of the reaction vessel 6.

[0029] A regulation unit 38 is by means of signal lines connected to a pressure sensor 40 for sensing the gas pressure P1

in the pulp shredding vessel 16 and to a pressure sensor 42 for sensing the gas pressure P2 in the reaction vessel 6. The regulation unit 38 is by means of further signal lines also connected to a fan 44 with a controllable capacity located in an upper outlet conduit 46 from the pulp shredding vessel 16, and to another fan 48 likewise with a controllable capacity located in the upper outlet conduit 36 of the reaction vessel 6.

[0030] During operation a pulp suspension is pumped through the inlet 12 of the dewatering device 2 to the pressure rolls 8, which are counter rotated by the motor 14, the direction of rotation of the pressure rolls being indicated by arrows in figure 3, so that the pulp is pulled between the pressure rolls 8 while being dewatered up to the inlet of the pulp shredding vessel 16. When entering the inlet of the pulp shredding vessel 16 the dewatered pulp has a fiber concentration of 20-45%. In the pulp shredding vessel 16 the pulp is shredded by the toothed transport thread 26 of the transport screw 18, which is rotated by the motor 20. Depending on the desired result the tothing of the transport thread 26 may be shaped so that a relatively coarse or fine shredding of the pulp is obtained. In addition the transport screw 18 transports shredded pulp through the outlet pipe 22 without compressing the pulp. From the outlet pipe 22 the shredded pulp drops through the vertical conduit 28 to the reaction vessel 6, where the pulp is bleached through reaction with ozone gas. Finally the bleached pulp is discharged from the reactor vessel 6 through the lower outlet conduit 32.

[0031] The regulation unit 38 controls the capacity of the fans 44 and 48, for instance by speed control, in response to the pressure sensors 40 and 42, so that the gas pressure P1 in the pulp shredding vessel 16 is kept higher than the gas pressure P2 in the reaction vessel 6. At least the gas pressure P2 is kept by the regulation unit 38 below the surrounding atmospheric pressure. Suitably the regulation unit 38 keeps the gas pressure P1 in the range of 0-14 kPa (overpressure) and the gas pressure P2 in the range 1-15 kPa (overpressure) at the same time as the regulation unit 38 regulates the pressure difference between the

gas pressures P1 and P2 towards a predetermined value, which is chosen in the range of about 0.5 to 1.5 kPa.

[0032] By the fact that the shredded and fluffed pulp transported by the transport screw 18 through the outlet pipe 22 completely fills the latter at the same time as the gas pressure is decreased from the interior of the pulp shredding vessel to the interior reactor vessel, ozone gas is efficiently prevented from passing upstream in the system to the surroundings.

[0033] Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

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ABSTRACT OF THE DISCLOSURE

Methods and systems for the treatment of pulp are provided. The methods include dewatering pulp to a fiber concentration of at least 20%, shredding the dewatered pulp in a closed pulp shredding vessel, transporting the shredded pulp without compression continuously out of the pulp shredding vessel through an outlet pipe which is kept completely filled with passing pulp, directly transporting the shredded pulp to a reaction vessel through a gas-tight conduit gas sealed from the surroundings and communicating with the outlet pipe and the reaction vessel, bleaching the shredded pulp in the reaction vessel with ozone gas, and regulating the gas pressure in the pulp shredding vessel and in the reaction vessel so that ozone gas is prevented from leaking upstream through the outlet pipe.

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METHOD AND SYSTEM FOR CONVEYING SHREDDED PULP TO AN OZONE REACTOR

The present invention relates to a method of treatment of pulp, which in a dewatering step is dewatered to a fibre concentration of at least 20% and which in a later bleaching step is bleached in an reactor vessel through reaction with ozone gas. The invention also relates to a system for treatment of pulp, comprising a dewatering device for dewatering the pulp to a fibre concentration of at least 20%, and a reactor vessel for bleaching the dewatered pulp through reaction with ozone gas.

In traditional systems for ozone bleaching of pulp at a high pulp concentration the pulp has to undergo a process comprising a number of preparatory treatment steps before the pulp finally can be bleached with ozone gas in the reactor vessel. Thus, the pulp is dewatered in an initial dewatering step in the dewatering device, usually in the form of a twin roll press. The dewatered pulp is shredded in a subsequent pulp shredding step in a shredder. The dewatered and shredded pulp is then transported in a transporting step, usually by a plug screw, from the shredder to a fluffer, in which the pulp is fluffed in a fluffing step. Once the pulp has undergone these preparatory steps it can be bleached in the reactor vessel.

The function of said plug screw is to compress the shredded pulp to a plug forming a gas lock preventing ozone gas from leaking from the reaction vessel upstream in the system to the surroundings. The function of the fluffer is to fluff up the compressed pulp leaving the pulp screw, so that the pulp gets a large specific surface, which facilitates the reaction of the ozone gas with the lignin of the pulp. Thus, the pulp entering the reactor vessel has to be fluffed, in order to obtain a high ozone utilisation and a good bleaching selectivity.

WO 9605365A1 shows a known pulp treatment system

comprising a pulp plug forming plug screw for transportation of dewatered and shredded pulp to a fluffer, and a reaction vessel containing pulp bleaching gas.

Thus, the above described traditional pulp treatment system for bleaching pulp with ozone gas is relatively extensive and consequently expensive, which is a disadvantage. In addition, with several treatment steps in the process the entire system will be more sensitive to disturbances in each single part of the process. Therefore it would be of advantage if one or more treatment steps could be eliminated.

An object of the present invention is to provide a new method for treating pulp, which is bleached through reaction with ozone gas, which method is simpler and more reliable than traditional methods and results in an efficient ozone utilisation for the bleaching of the pulp.

This object is achieved by the method stated initially, which is characterised in that after the dewatering step and before the bleaching step the pulp is shredded in a closed pulp shredding vessel, the shredded pulp is transported without compression continuously out of the pulp shredding vessel through an outlet pipe therefrom, so that the outlet pipe is kept filled with passing pulp, from the outlet pipe of the pulp shredding vessel the shredded pulp is directly transported to the reaction vessel through a conduit which is gas sealed from the surroundings, the interior of the conduit communicating with the interior of the outlet pipe and with the interior of the reactor vessel, and the gas pressure in the pulp shredding vessel is kept higher than the gas pressure in the reactor vessel.

It has been proved that the combination of the two measures - (1) to keep the outlet pipe filled with passing shredded non-compressed pulp, and - (2) to maintain the gas pressure in the pulp shredding vessel higher than that of the

reactor vessel, is sufficient to prevent ozone gas from leaking upstream out to the surroundings. Hereby neither a plug screw nor a fluffer is needed, which makes the new method according to the invention particularly simple and reliable.

Advantageously the pressure difference between the gas pressure in the pulp shredding vessel and the gas pressure in the reactor vessel is regulated towards a predetermined value, wherein the gas pressures in the pulp shredding vessel and the reactor vessel are suitably kept under the surrounding atmospheric pressure.

Preferably, the shredded pulp is transported in the gas-tight conduit by the aid of gravity without need for any mechanical transportation means.

In the pulp shredding vessel the pulp is advantageously shredded by a transport screw with at least one toothed thread, wherein the transport screw also provides the transportation of the shredded pulp through the outlet pipe of the pulp shredding vessel.

A further object of the present invention is to provide a new system for treating pulp, which is bleached through reaction with ozone gas, which system is simpler than the above described traditional systems and eliminates the above mentioned disadvantages and problems thereof.

This object is obtained by the system stated initially, which is characterised by a pulp shredding device for shredding the dewatered pulp, which pulp shredding device comprises a closed pulp shredding vessel, an outlet pipe from the pulp shredding vessel, and a transport means for continuous transport of the shredded pulp without compressing the pulp out of the pulp shredding vessel via the outlet pipe, so that the latter is kept filled with passing pulp, a conduit which is gas sealed from the surroundings and which connects the outlet pipe of the pulp shredding vessel gas

tightly to the reaction vessel, so that the interior of the outlet pipe directly communicates with the reaction vessel via the interior of the conduit, and a pressure regulation device for maintaining a gas pressure in the pulp shredding vessel which is higher than that of the reaction vessel.

According to a preferred embodiment of the system according to the invention the transport means comprises a transport screw extending in the pulp shredding vessel, preferably also in the outlet pipe of the pulp shredding vessel, and which is provided with at least one toothed thread for shredding the pulp.

Advantageously the pressure regulation device regulates the pressure difference between the gas pressure in the pulp shredding vessel and the gas pressure in the reactor vessel toward a predetermined value.

Preferably the pressure regulation device comprises a first fan with a controllable capacity arranged in a gas outlet in the pulp shredding vessel for evacuation of gas therefrom, a second fan with controllable capacity arranged in a gas outlet in the reactor vessel for evacuation of gas therefrom, a first pressure sensor for sensing the gas pressure in the pulp shredding vessel, a second pressure sensor for sensing a gas pressure in the reaction vessel, and a regulation unit which in response to the first and second pressure sensors, respectively, regulates the capacity of the first and second fans, respectively.

The invention is described in more detail in the following with reference to the accompanying drawing, in which figure 1 schematically shows an example of the system according to the present invention, and figure 2 and 3, respectively, is a cross section along the line II-II and III-III, respectively, in figure 1.

The drawing shows a system for treatment of pulp comprising a dewatering device 2, a pulp shredding device 4

and a reaction vessel 6 for bleaching of pulp through reaction with ozone gas. The dewatering device 2 comprises two pressure rolls 8, which are arranged to counter rotate in a housing 10, and an inlet 12 for pulp to be dewatered in the lower part of the housing 10. A motor 14 provides for the rotation of the pressure rolls 8. An elongated closed pulp shredding vessel 16 extends along the pressure rolls 8 above these. In the pulp shredding vessel 16 a transport screw 18 extends in parallel with the pressure rolls 8. Another motor 20 is adapted to rotate the transport screw 18. The pulp shredding vessel 16 has a lower elongated inlet for pulp to be dewatered by the pressure rolls 8, see figure 2 and an outlet pipe 22, through which the transport screw 18 extends in part, for dewatered and shredded pulp.

The transport screw 18 has a core 24 with a constant diameter and a toothed transport thread 26 with a constant pitch and diameter. The portion of the transport thread 26 extending in the outlet pipe 22 may alternatively be non-toothed. The interior of the outlet pipe 22 also has a constant diameter which is somewhat larger than the diameter of the transport thread 26. Alternatively the transport screw 18 may have more than one transport thread 26.

A vertical gas-tight conduit 28 connects the outlet pipe 22 gas-tightly to an upper inlet 30 in the reaction vessel 6, so that the interior of the outlet pipe 22 directly communicates with the interior of the reaction vessel 6 via the interior of the conduit 28. The reaction vessel 6 has a lower outlet conduit 32 provided with a valve 34, for discharge of bleached pulp, and an upper outlet conduit 36 for evacuation of gas. There is also a device, not shown, for supplying ozone gas to the interior of the reaction vessel 6.

A regulation unit 38 is by means of signal lines connected to a pressure sensor 40 for sensing the gas pressure P1 in the pulp shredding vessel 16 and to a pressure

sensor 42 for sensing the gas pressure P2 in the reaction vessel 6. The regulation unit 38 is by means of further signal lines also connected to a fan 44 with a controllable capacity located in an upper outlet conduit 46 from the pulp shredding vessel 16, and to another fan 48 likewise with a controllable capacity located in the upper outlet conduit 36 of the reaction vessel 6.

During operation a pulp suspension is pumped through the inlet 12 of the dewatering device 2 to the pressure rolls 8, which are counter rotated by the motor 14, the direction of rotation of the pressure rolls being indicated by arrows in figure 3, so that the pulp is pulled between the pressure rolls 8 while being dewatered up to the inlet of the pulp shredding vessel 16. When entering the inlet of the pulp shredding vessel 16 the dewatered pulp has a fibre concentration of 20-45%. In the pulp shredding vessel 16 the pulp is shredded by the toothed transport thread 26 of the transport screw 18, which is rotated by the motor 20. Depending on the desired result the toothing of the transport thread 26 may be shaped so that a relatively coarse or fine shredding of the pulp is obtained. In addition the transport screw 18 transports shredded pulp through the outlet pipe 22 without compressing the pulp. From the outlet pipe 22 the shredded pulp drops through the vertical conduit 28 to the reaction vessel 6, where the pulp is bleached through reaction with ozone gas. Finally the bleached pulp is discharged from the reactor vessel 6 through the lower outlet conduit 32.

The regulation unit 38 controls the capacity of the fans 44 and 48, for instance by speed control, in response to the pressure sensors 40 and 42, so that the gas pressure P1 in the pulp shredding vessel 16 is kept higher than the gas pressure P2 in the reaction vessel 6. At least the gas pressure P2 is kept by the regulation unit 38 below the

surrounding atmospheric pressure. Suitably the regulation unit 38 keeps the gas pressure P1 in the range of 0-14 kPa (overpressure) and the gas pressure P2 in the range 1-15 kPa (overpressure) at the same time as the regulation unit 38
5 regulates the pressure difference between the gas pressures P1 and P2 towards a predetermined value, which is chosen in the range of 0,5-1,5 kPa.

By the fact that the shredded and fluffed pulp transported by the transport screw 18 through the outlet pipe 22
10 completely fills the latter at the same time as the gas pressure is decreased from the interior of the pulp shredding vessel to the interior reactor vessel, ozone gas is efficiently prevented from passing upstream in the system to the surroundings.

CLAIMS

1. A method of treating of pulp, which in a dewatering step is dewatered to a fibre concentration of at least 20% and
5 which in a later bleaching step is bleached in a reaction vessel (6) through reaction with ozone gas, **characterised in that**

- after the dewatering step and before the bleaching step the pulp is shredded in a closed pulp shredding vessel (16),

10 - the shredded pulp is transported without compression continuously out of the pulp shredding vessel through an outlet pipe (22) therefrom, so that the outlet pipe is kept completely filled with passing pulp,

- from the outlet pipe of the pulp shredding vessel the
15 shredded pulp is directly transported to the reactor vessel (6) through a gas-tight conduit (28) which is gas sealed from the surroundings, the interior of the conduit communicating with the interior of the outlet pipe and with the interior of the reaction vessel, and

20 - the gas pressure (P1) in the pulp shredding vessel is kept higher than the gas pressure (P2) in the reaction vessel.

2. A method according to claim 1, **characterised in that** the pressure difference between the gas pressure (P1) in the pulp
25 shredding vessel (16) and the gas pressure (P2) in the reaction vessel (6) is regulated towards a predetermined value.

3. A method according to claim 2, **characterised in that** the
30 gas pressures (P1, P2) in the pulp shredding vessel (16) and the reaction vessel (6) are kept below the surrounding atmospheric pressure.

4. A method according to any of claims 1-3, **characterised in** that the shredded pulp is transported by gravity in the gas-tight conduit (28).

5. A method according to any of claims 1-4, **characterised in** that in the pulp shredding vessel (16) the pulp is shredded by a transport screw (18) with at least one toothed transport thread (26), the transport screw also providing a transport of the shredded pulp through the outlet pipe (22) of the pulp shredding vessel.

6. A system for treatment of pulp, comprising a dewatering device (2) for dewatering the pulp to a fibre concentration of at least 20%, and a reaction vessel (6) for bleaching the dewatered pulp through reaction with ozone gas, **characterised by** a pulp shredding device (4) for shredding the dewatered pulp, which pulp shredding device comprises a closed pulp shredding vessel (16), an outlet pipe (22) from the pulp shredding vessel, and a transport means (18) for continuous transport of the shredded pulp without compressing the pulp out of the pulp shredding vessel via the outlet pipe, so that the latter is kept filled with passing pulp, a conduit (28) which is gas sealed from the surroundings and connects the outlet pipe of the pulp shredding vessel gas-tightly to the reaction vessel, so that the interior of the outlet pipe directly communicates with the interior of the reaction vessel through the interior of the conduit, and a pressure regulation device (38, 40, 42, 44, 48) for maintaining a gas pressure (P1) in the pulp shredding vessel which is higher than the gas pressure (P2) in the reaction vessel.

7. A system for treatment of pulp according to claim 6, **characterised in** that the transport means comprises a transport screw (18) extending in the pulp shredding vessel

(16) and provided with at least one toothed transport thread (26) for shredding the pulp.

8. A system for treatment of pulp according to claim 7,
5 **characterised in** that the transport screw (18) also extends in the outlet pipe (22) of the pulp shredding vessel (16).

9. A system for treatment of pulp according to any of claims
10 6-8, **characterised in** that the pressure regulation device (38, 40, 42, 44, 48) regulates the pressure difference between the gas pressure (P1) in the pulp shredding vessel (16) and the gas pressure (P2) in the reaction vessel (6) towards a predetermined value.

15 10. A system for treatment of pulp according to claim 9, **characterised in** that the pressure regulation device (38, 40, 42, 44, 48) comprises a first fan (44) with controllable capacity arranged in a gas outlet (46) in the pulp shredding vessel (16) for evacuation of gas therefrom, a second fan
20 (48) with controllable capacity arranged in a gas outlet (36) in the reaction vessel (6) for evacuation of gas therefrom, a first pressure sensor (40) for sensing the gas pressure (P1) in the pulp shredding vessel (16), a second pressure sensor (42) for sensing the gas pressure (P2) in the reaction vessel
25 (6), and a regulation unit (38) which in response to the first and second pressure sensors, respectively, regulates the capacity of the first and second fans, respectively.

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION

ATTORNEY'S DOCKET NO.: B&LAB-009

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: METHOD AND SYSTEM
FOR CONVEYING SHREDDED PULP TO AN OZONE REACTOR, the specification of which

☐ is attached hereto

☒ was filed on May 24, 2000 as United States Application Number or PCT International Application Number PCT/SE00/01052 and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)			
COUNTRY	APPLICATION NUMBER	DATE OF FILING (month, day, year)	PRIORITY CLAIMED
SE	9902178-4	June 10, 1999	YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>
			YES <input type="checkbox"/> NO <input type="checkbox"/>
			YES <input type="checkbox"/> NO <input type="checkbox"/>

LISTING OF FOREIGN APPLICATIONS CONTINUED ON PAGE 3 HEREOF ☐ YES ☒ NO

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

Application Number: _____ Filing Date: _____

Application Number: _____ Filing Date: _____

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or § 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

U.S. Parent Application Serial Number: _____ Parent Filing Date: _____ Parent Patent No.: _____

U.S. Parent Application Serial Number: _____ Parent Filing Date: _____ Parent Patent No.: _____

PCT Parent Number: _____ Parent Filing Date: _____

LISTING OF US APPLICATIONS CONTINUED ON PAGE 3 HEREOF: ☐ YES ☒ NO

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

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DECLARATION -- Page 2

ATTORNEY DOCKET NO. B&LAB-009

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor (given name, family name): Monica Bokström

Inventor's signature M. Bokström Date October 22, 2001

Residence: Kovland, Sweden SEX SE Citizenship: Swedish

Post Office Address: Bjärme 3251, S-860 25 KOVLAND, Sweden

Full name of second joint inventor, if any (given name, family name): Per Åström

Second Inventor's signature Per Åström Date October 22, 2001

Residence: Kovland, Sweden SEX SE Citizenship: Swedish

Post Office Address: Bjärme 3251, S-860 25 KOVLAND, Sweden

Full name of third joint inventor, if any (given name, family name): _____

Third Inventor's signature _____ Date _____

Residence: _____ Citizenship: _____

Post Office Address: _____

Full name of fourth joint inventor, if any (given name, family name): _____

Fourth Inventor's signature _____ Date _____

Residence: _____ Citizenship: _____

Post Office Address: _____

Full name of fifth joint inventor, if any (given name, family name): _____

Fifth Inventor's signature _____ Date _____

Residence: _____ Citizenship: _____

Post Office Address: _____

Full name of sixth joint inventor, if any (given name, family name): _____

Sixth Inventor's signature _____ Date _____

Residence: _____ Citizenship: _____

Post Office Address: _____

Full name of seventh joint inventor, if any (given name, family name): _____

Seventh Inventor's signature _____ Date _____

Residence: _____ Citizenship: _____

Post Office Address: _____

Full name of eighth joint inventor, if any (given name, family name): _____

Eighth Inventor's signature _____ Date _____

Residence: _____ Citizenship: _____

Post Office Address: _____